

17. Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. By FRANK E. BEDDARD, M.A., D.Sc., F.R.S., F.Z.S., Prosector to the Society.

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(Text-figures 1-8.)

XIII. ON TWO NEW SPECIES BELONGING TO THE GENERA *OoCHORISTICA* AND *LINSTOWIA*, WITH REMARKS UPON THOSE GENERA.

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The material upon which the following observations are based was collected at the Society's Gardens during September and October of last year, and suitably preserved for microscopical examination. I was only able to make observations upon the living worm in the case of *Oochoristica marmosa*. Both worms were parasitic in the small intestine of their host.

§ *LINSTOWIA AMEIVÆ*, sp. n.

I have examined three examples of a Cestode from the Surinam Lizard, *Ameiva surinamensis*, which I place—at any rate, for the present—in the genus *Linstowia*; for I shall call attention on a subsequent page (p. 281) to the difficulty of distinguishing *Linstowia* and *Oochoristica* as they have been defined up to the present time.

The worm is a small one, measuring up to 25 mm. in length with a diameter (where it is broadest) of 1.5 mm. There is no rostellum and the four suckers are unarmed. The scolex (when the worm, at any rate, is in a state of contraction) is not wider than the body which follows; the latter gradually increases in diameter. A neck is present in which no segmentation occurs; the rudiments of the generative organs appear almost coincidently with the commencement of segmentation. The only other external character to be noted is the alternation of the genital apertures, which are always anterior in position in the segment. In transverse sections the cortical layer is seen to be thick, its diameter in both dorsal and ventral layers being fully as great as that of the entire medullary layer in the same section. This is one of the reasons which lead me to refer the present species to the genus *Linstowia* as commonly defined.

Such sections also show the disposal of the longitudinal muscle-fibres into bundles. As will be seen from text-fig. 4 (p. 270) there is only one row of bundles, which is by no means so marked as is that in two other species belonging to the same genus or to

Oochoristica, and which are represented in the same figure for the purpose of a readier comparison. In *Linstowia ameivæ* the bundles contain a varying number of fibres—from as few as two or even one up to nine or ten. Midway between this inner longitudinal layer and the subcuticula is an outer layer of longitudinal fibres, which are largely implanted singly or in twos, and everywhere form a much thinner layer than the inner row.

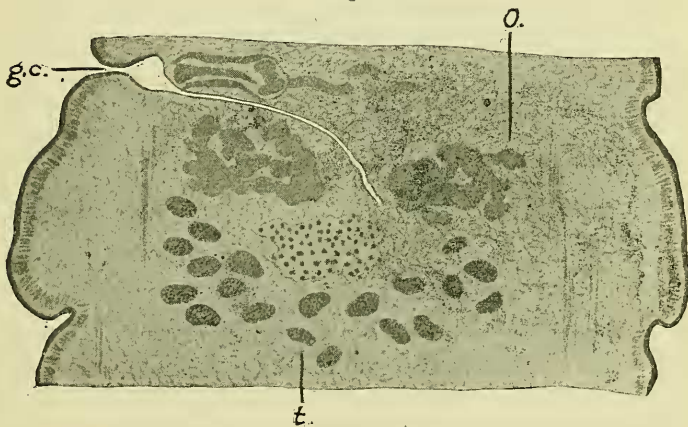
The *water-vascular system* is like that of other species of *Linstowia*; but it is not always quite easy to interpret the facts. In transverse sections I have seen the smaller dorsal vessel lying above the ventral either directly or more obliquely; and this in quite neighbouring sections, in others of which the two vessels lay side by side, the dorsal outermost, *i.e.* nearer to the nerve-cord. This is evidently due to the varying degree of contraction of the proglottids, a fact also emphasized by the zigzag course of the vessels when viewed in horizontal sections. I believe that the normal position of these vessels is side by side. The inner and larger of the two tubes, which I regard as the ventral vessel, gives off several branches in each segment, which are themselves branched. There also appear to be connections between the ventral and dorsal vessels. I cannot, however, give a map of this network.

The *testes* lie posteriorly to the vitelline gland, and reach forward on either side of it; they do not, however, extend laterally of the ovary. In a given segment the testes were visible in 18 consecutive sections. The largest number counted in the middle of the series was 43. I therefore calculate the total number to be about 200. The testes do not extend laterally beyond the lateral water-vascular vessels.

The *genital ducts* of this tapeworm open on to the exterior, as already mentioned, alternately, with, however, no absolute regularity in the alternation. They both open—the cirrus-sac in front of the vagina—into a *genital cloaca*, whose external pore is close to the anterior margin of the proglottid. This genital cloaca is separated into two regions, which are obviously of different morphological value. Outside is a funnel-shaped chamber, the apex of the funnel lying to the inside. In longitudinal sections through the cirrus-sac it was occasionally noted that the bottom of the funnel was almost completely closed, leaving but a narrow slit of communication with the inner chamber of the genital cloaca. The latter is roughly spherical in form, and receives the openings of the cirrus-sac and the vagina. Its depth is not very different from that of the outer funnel-shaped region. In longitudinal sections, it is seen to be marked off from the outer chamber by a projection on either side which is the expression in such a section of a circular fold. This fold is muscular and a thick layer of muscles, of which it is a part, encircles the whole of the spherical chamber of the genital cloaca. The *cirrus-sac* lies in the same straight line with the genital cloaca, and is thus at right angles with the long axis of the body of the worm. The cirrus-

sac is somewhat hourglass-shaped through being compressed in the middle; but the anterior end, *i. e.* that nearest the exterior of the body, is not so wide as the posterior end. The cirrus-sac has a thick muscular coat, which thins out only posteriorly; this end of the cirrus is thin-walled and globular in shape. The cirrus-sac of this *Linstowia* is large, but not so large as in *L. echidnæ* and *L. semoni*. In the ripe segments the total length of the cirrus-sac and the genital cloaca is between $\frac{1}{4}$ and $\frac{1}{3}$ of the body diameter; more anteriorly, where the cirrus-sac is not fully formed, but still differentiated from the sperm-duct, and where the body is narrower, the length is between $\frac{1}{4}$ and $\frac{1}{3}$ of the diameter of the proglottid. The end of the cirrus-sac lies considerably to the inside of the nerve-cord; it reaches the level of the innermost of the longitudinal water-vascular trunks.

Text-figure 1.

*Linstowia ameivæ*.

Horizontal section of a proglottid in which the uterine cavities are not yet developed.

g.c. Genital cloaca. *O.* Ovary between which and testes, *t.* lies vitelline gland, not lettered.

I note, finally, that the lateral nerve-cord, where it is crossed by the cirrus-sac, is bent outwards for a space. Soon after issuing from the cirrus-sac the *sperm-duct*, at first only sinuous, forms a coil; this region of the vas deferens is surrounded by laxer parenchymal tissue than that which pervades the body generally, but which presents no glandular characters.

The *vitelline gland* of this species presents the usual characters. It lies at about the middle of the proglottid antero-posteriorly, as well as from side to side. It is smaller in horizontal diameter than the ovary, which lies in front of it, or than the mass of

testes, which lies behind it. The vitelline gland is not in contact with the ovary, and between them lies the shell-gland. In a complete series of horizontal sections, it can be observed that the vitelline gland extends further ventrally than any of the gonads and that it nearly reaches the dorsal limits of the medulla. The duct of this gland is comparatively wide where it leaves it anteriorly, but soon narrows. The vitelline gland is later in its growth than the ovary, for, in earlier proglottids than such as are referred to in the above description, the vitelline gland is proportionately considerably smaller than the ovary.

The *ovary* is single and as nearly as possible in the middle of the body. It is, as is so usual, mainly developed laterally in two wings. The ovary lies in front of the vitelline gland and of the testes; it is very near to the anterior border of the proglottid. The ovary, as is usual, is not solid and compact, but frayed out laterally in a digitiform fashion. The ovary extends laterally beyond the vitelline glands, but not so far as do the testes.

The *female efferent apparatus* is simpler than in many tape-worms. It opens into the genital cloaca by an expanded funnel-shaped mouth lying behind the entry of the cirrus-sac. The vagina runs a straight course to about the middle of the proglottid, where it bends posteriorly and becomes coiled before opening into the shell-gland. There is no dilatation along its course—nothing that can be described as a receptaculum seminis. Even in quite ripe proglottids there is no change in the female duct, except a slight diminution of the always narrow lumen.

§ *Uterus and Embryos.*

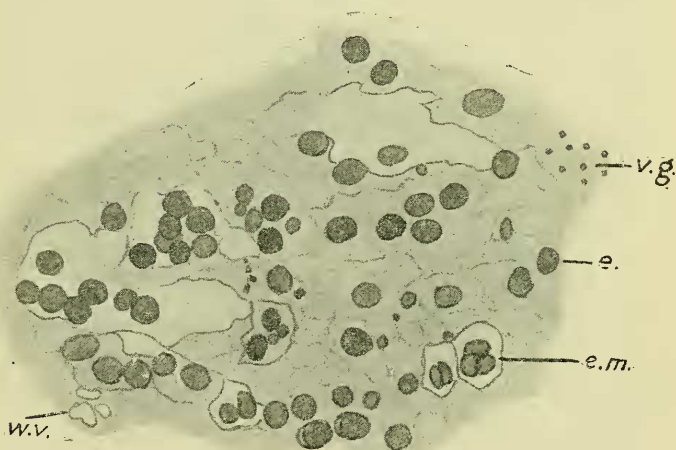
In this species, as in others referred to the genera *Linstowia* and *Oochoristica*, a uterus exists for a space; but later the embryos come to be implanted singly in the parenchyma of the body.

One remarkable feature of the uterus in this species is its sudden appearance. In one proglottid there is no trace that I could discover of a uterus. In the immediately following proglottid the uterus was present in a well-developed condition. Its general appearance under a low power is shown in text-fig. 2. The ripe ova (*ova* at this stage, not embryos) are found over a large area of the proglottid, but limited to the medullary region: indeed, they do not extend outside of the lateral trunks of the water-vascular system. These scattered ova are found in front of the ovary as well as behind it; they also occur among the testes, where the latter begin to thin out ventrally. They are thus mainly ventral in position, the testes being mainly dorsal.

Although the cavities lodging the ova have, so far, been spoken of inferentially as a uterus, there is no continuous uterus in this worm with its own definite walls. On a rapid glance at such a section as that which is represented in text-fig. 2, the impression given may be that the ova are contained in a series of circular or

oval spaces which intercommunicate. A more careful examination, however, under higher powers, does not entirely confirm such an impression. There are undoubtedly cavities of varying dimensions in which one or more eggs often lie; these cavities are, to some extent, of irregular shapes, and their prolongations may anastomose. But there is no doubt that there are cavities containing eggs which are entirely isolated from the others. There is, in fact, nothing that can be described as a branched or retiform uterus with a continuous cavity. And it is to be observed that I am here speaking of the earliest proglottids in which the uterus occurs—not of later segments where it might have been broken up into detached cavities. Moreover, a nearer inspection of some

Text-figure 2.



Liostowia ameivæ.

Portion of a section through a ripe proglottid showing disposition of ova.

e. Ova lying in parenchyma. *e.m.* Ova lying in definite uterine spaces.
v.g. Remains of vitelline gland. *w.v.* Water-vascular tubes.

of the egg-containing cavities shows that they are traversed by delicate strands of tissue—that, in fact, they are not really all of them cavities, but are merely looser regions of the delicate network which chiefly constitutes the medullary parenchyma. Furthermore, plenty of eggs are placed singly between the meshes of the parenchyma enclosed in no special cavities and even lying just outside of such cavities as have been described above. Some of these eggs have already formed embryos; but perhaps the majority are still in the unicellular condition. These eggs, whether lying singly in the parenchyma or a few together in cavities, extend over much of the proglottid and are quite in

contact with the anteriorly situated ovary. It is impossible to say where ovary ends and "uterus" begins. There is nothing in these facts to forbid the assumption that the eggs leave the ovary and migrate directly into the parenchyma, not reaching it *via* a uterus.

Towards the end of the body the uterine cavities, if they be such, have completely disappeared, and the embryos (text-fig. 3) are more or less evenly scattered through the parenchyma. They even get to be found in the cortical parenchyma, though by no means numerous. It is not infrequent among tapeworms for

Text-figure 3.



Linstowia ameiva.

Portion of a section through a more fully ripe proglottid than that represented in text-fig. 2, and also more highly magnified.

- A. Outermost membrane of the embryo. B. Middle membrane.
C. Embryo surrounded by delicate innermost membranes.

the ripe embryos to lie also in the cortical parenchyma; and in an ally of the present species, viz. *Linstowia brasiliensis*, the eggs stray thither*. The ripe embryos of the present species are hexacanth, as is usual; each appears to be wrapped in three shells—unless the outermost membrane, which is more stainable by hæmatoxylin, be regarded as belonging to the maternal tissues. The spaces of the parenchyma, in one of which each embryo lies, fit the shells fairly accurately, and show no signs of being independent cavities lined by an epithelium.

* v. Janicki, Zeitschr. wiss. Zool. lxxxi. 1906, Taf. xx. fig. 2.

The principal features in the anatomy of this worm may be thus summed up :—

Linstowia ameivæ, sp. n.

Length up to 25 mm.; greatest diameter 1.5 mm. *Rostellum* absent; four suckers unarmed. A neck present; posterior segments increased in length, but not longer than wide. Genital pores alternate in position, close to anterior margin of segment. Cortical layer thick, about the same diameter as medullary layer; longitudinal muscles in two layers, innermost of small bundles of fibres not more than 8 or 10 to a bundle, and often less, outermost layers of fibres implanted singly or in twos. Water-vascular tubes lie side by side, the smaller dorsal tube being external; there is also a network of excretory tubes. The testes lie posteriorly to the ovary and vitelline gland, and extend to the dorsal surface, but do not overlap female gonads; cirrus-sac moderately large with muscular walls opening into genital cloaca in front of vagina, cirrus without spines; sperm-duct coiled, without *vesicula seminalis*. Ovary single with lateral wings, lying in front of segment. Vitelline gland, not so extensive, lies behind. Vagina without dilated *receptaculum seminis*. Eggs lie at first partly within scattered cavities in the parenchyma and partly between the meshes of the same; later no cavities are to be seen and the ova are imbedded singly in the parenchyma; the eggs are surrounded by three shells.

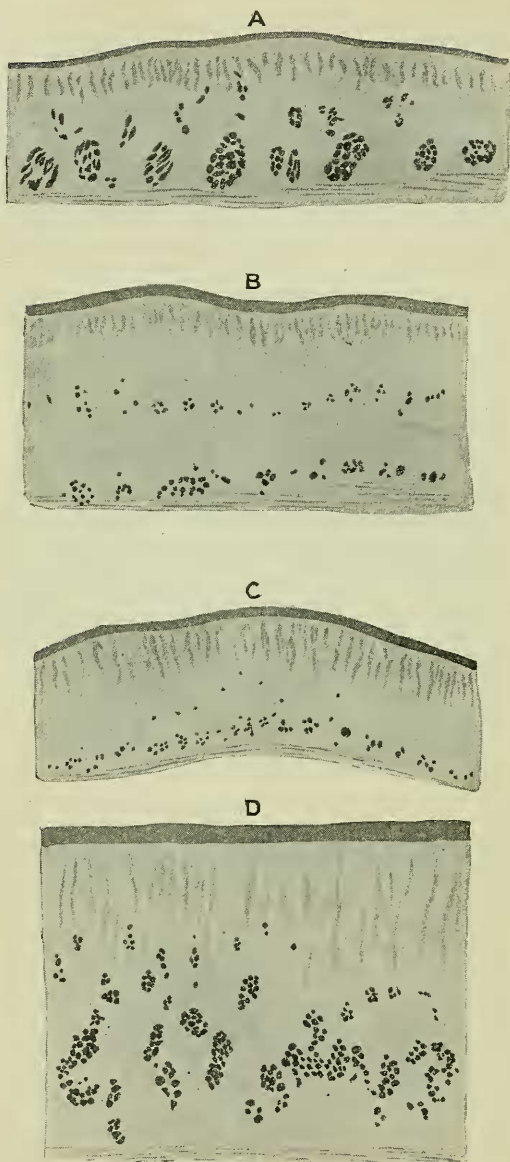
Hab. *Ameiva surinamensis*.

Oochoristica marmosæ, sp. n.

Of this new species I have been able to examine but a single specimen, which was obtained from an American Marsupial, *Marmosa elegans*. The specimen was not all in one piece; but, if the pieces were all of one individual, the length is 84 mm. Otherwise the length of the largest piece, which included the scolex, was 54 mm. The greatest breadth of a ripe proglottid is slightly under three millimetres. During life the posterior segments were extended to a length of rather more than twice their width. They were quite retracted by alcohol and became shorter than broad. The unarmed head has the usual four suckers, which are directed upwards. There is thus nothing distinctive in the external characters of this species. The generative pores are not visible, except by the section method; for they open anteriorly in each proglottid and their orifices are covered by an overlap of the proglottid in front. These pores alternate irregularly from side to side of the body as in all other species of *Oochoristica*.

In transverse sections through this tapeworm it may be seen that it agrees with *Oochoristica*, as opposed to *Linstowia*, in the comparative thinness of the cortical layer, which is less in diameter than the medullary layer. The muscular layers in the cortex have a characteristic arrangement (text-fig. 4, A), which

Text-figure 4.



A series of transverse sections through the cortex of various species of *Oochoristica* and *Linstowia*, to illustrate the arrangement of the longitudinal musculature.

A. *Oochoristica marmosæ*. B. *Linstowia ameivæ*. C. *L. echidnæ* or *semoni*.
D. *Oochoristica* sp.

may be compared, in the figure cited, with those of other and allied species (text-fig. 4, B, C, D). In the present species a delicate layer of transverse fibres forms the innermost layer of the cortex and separates it off from the medulla. Immediately outside of this is a layer of longitudinal fibres disposed in stoutish bundles separated from each other by considerable intervals. Outside of these again are scattered longitudinal fibres, which are here and there aggregated into small bundles of two or three fibres. The large internally situated bundles consist of 15-20 fibres apiece.

Text-fig. 4, B, illustrates a corresponding section through *Linstowia ameiva*, which I have already described*, and which shows plain differences from *Oochoristica marmose*.

For the purpose of comparison with these two species and to show the value as specific marks of the arrangement of the longitudinal muscles, I subjoin corresponding figures of a *Linstowia* from *Echidna* (text-fig. 4, C) which may be *L. echidnae* or *L. semoni* (I have no means of deciding the point), and of *Oochoristica* (text-fig. 4, D), which is near to and possibly identical with *O. wagneri*, whose general anatomy has been described by myself lately†. In the former species (text-fig. 4, C) the longitudinal muscular layer is divisible, as in the other species, into two sheets, of which, as before, the innermost is the stronger. So much so, however, that the outer muscular sheath is reduced to a very few fibres. The inner stronger layer is not by any means so well developed as in the last two species: the bundles are smaller, that is, they contain fewer fibres, and they are not by any means so distinctly marked off from one another as in *Oochoristica marmose*; they resemble more *Linstowia ameiva*, a point of importance in view of possible generic identity.

The last species represented in the figure (text-fig. 4, D) is quite unlike any of the others, in that there is not a definite two-layered disposition of the muscular fibres. There is simply one irregular layer of bundles of varying sizes, that is, containing a variable number of muscular fibres, which together occupy a good deal of the space which lies between the subcuticular layer and the transverse muscular layer. It will be observed, however, that, on the whole, the larger bundles lie to the deeper side of the cortical layer, those more superficially placed being smaller. On the whole, the arrangement of the longitudinal muscles in this species is more like that of *Oochoristica marmose* than of the other two species figured, by virtue of the size of the bundles. But if we attempt to draw generic definitions from this character, it might perhaps be urged with equal force that the reduction of the muscles in *Linstowia semoni* sets that species apart from all the rest. In any case, it cannot be doubted that these muscles furnish very clear specific characters which have not been hitherto sufficiently represented in figures illustrating these two genera.

* *Supra*, p. 264.

† P. Z. S. 1911, p. 627.

In both transverse and longitudinal sections only two large longitudinally running trunks of the water-vascular system are to be seen. These two trunks, as is so often the case, are of quite different dimensions. The dorsal tube, which is very much smaller than the ventral, lies above it, sometimes also rather to the inside, and has thicker walls. This tube is so fine that I have occasionally been unable to find it in a given section, though it would appear to be quite a continuous vessel. Below lies the very much larger ventral tube. This is situated at some distance to the inside of the nerve-cord. In the existence of but two principal longitudinal water-vascular tubes the present species agrees with the other two forms which are found in South American Marsupials, and also with the recently described species named by Zschokke *Oochoristica rostellata**; in the latter case, however, the two tubes, dorsal and ventral, are of about the same calibre, as is shown in his figure of a transverse section through a proglottid of that worm. In longitudinal sections the same two tubes are always quite visible.

To these two principal longitudinal tubes on each side of the proglottid a third may be added, which is, however, not comparable with the additional tubes found in certain species of *Oochoristica* from S. American Edentates. One does not find in transverse sections six conspicuous longitudinal vessels such as are so plain in an *Oochoristica* from *Tamandua*, upon which I have recently reported to the Society. But, on the other hand, the anastomosis between the branches of the excretory network which pervades the segments does lead to the formation of at least short longitudinal trunks. I have observed such a one lying outside of the nerve-cord. The branches of the water-vascular system in this species are indeed very copiously developed. Four or five, or even more, large branches from the ventral vessels pass across the proglottids, and even more are directed towards the lateral margin passing across the nerve-cord. The whole body is, in fact, richly supplied by a plexus, of which the individual tubes are often wide. I have not been able to ascertain whether any of these branches perforate the cortex and reach the exterior of the body.

§ *Male Gonads and Ducts.*

The relative positions of the male and female gonads in this group are frequently made use of as a generic distinction. The present genus, *Oochoristica*, has been partly defined thus by Ransom†:—"Testicles numerous, surround female glands posteriorly and on the sides." The figure given of *O. rostellata* by Zschokke‡ is in accord with this definition; and so are certain of the figures given by v. Janicki§. Not, however, his illustrations of the species *O. bivittata* and *O. didelphydis*, which are

* Zeitschr. wiss. Zool. Bd. lxxxiii. 1905, pl. i. fig. 2.

† Bull. U.S. Nat. Mus. No. 69, 1909, p. 85.

‡ Zeitschr. wiss. Zool. Bd. lxxxiii. 1905, pl. i. fig. 3.

§ *Ibid.* Bd. lxxxi. 1906, pl. xx. figs. 5, 7, pl. xxi. figs. 18, 21.

for certain reasons (geographical distribution and host) to be compared particularly with that which forms the subject of the present communication. In these two species the testes are entirely posterior to the female gonads. It seems possible that some differences are to be accounted for by the state of contraction of the proglottids.

In *Oochoristica marmosæ*, in those proglottids where they are at the height of their development, the testes are mainly to be found at the sides of the centrally placed ovary and vitelline gland, which are themselves very large and occupy most of the central region of the proglottid, both dorso-ventrally and antero-posteriorly. The testes extend above the female gonads dorsally, and there is a single row of them posteriorly behind the vitelline gland—in fact, they occupy pretty well all of the available space within the proglottid. They are numerous—I have counted as many as 50 in a single horizontal section. Inasmuch as a single proglottid cut horizontally was displayed in 25 sections (*not* including sections through the cortex), the number of testes is obviously large, even though the first and last sections only show one or two testes. The largest number given by Zschokke in his review of the genus is 100 for *O. rostellata*. My species must considerably exceed that.

The vas deferens opens through the cirrus-sac into a genital cloaca. The *genital cloaca* is less conspicuous in this *Oochoristica* than it is in some other tapeworms. It is in depth about one-third of the length of the cirrus-sac, which is itself small, and has no marked specialization into regions such as occurs, for example, in *Eugonodæum ædicnemii**. It is narrow and tubular in horizontal section, and the cirrus-sac opens into it at its internal extremity. It is surrounded by muscle-fibres, which doubtless act as a sphincter. This orifice is in front of that of the vagina. The *cirrus-sac* is small and only extends back as far as the nerve-cord. It is as usual bottle-shaped, being wider posteriorly, where also the muscular wall is much thinner. I could discover no spines upon the contained cirrus, which widens out and becomes very muscular at its outer end. Altogether there is nothing remarkable about the cirrus-sac and cirrus of this *Oochoristica*. But its shape and size and the muscularity of its walls are important specific marks—for they differentiate it from *O. rostellata*.

The *vas deferens* issues from the cirrus-sac as a straight tube running parallel with the vagina. Later it forms a loose and not very extensive coil, and often bends backwards and breaks up into a number of branches, which again become subdivided to supply the individual testes. This region of the sperm-duct is of the nature of a network, for anastomoses exist between many of the branches. The walls of the finer branches of the sperm-duct and their communication are quite visible, even

* P. Z. S. 1913, p. 866, text-fig. 144.

under only moderately high powers; and when gorged with sperm they are not any more conspicuous.

§ *Female Gonads and Ducts.*

The *ovary* lies anteriorly in the proglottid, but is prevented from reaching the actual limit of the proglottid by the transverse uterus which lies in front of it. It consists of a central portion, which lies practically in the middle of the proglottid, and of two lateral wings. The latter are frayed out into numerous thick digitiform processes, which extend rather beyond the range of the posteriorly situated vitelline gland. In sections cut horizontally the digitiform outgrowths of the ovary have the appearance of circular or oval sacs filled with ova. They present the very closest resemblance to the sacs of the uterus which lie among them. The *vitelline gland* is rather smaller than the ovary, behind which it lies. It is very much of the same form, being prolonged laterally into blunt processes. The *vagina* runs at first a straight or slightly sinuous course behind the vas deferens; it then bends backwards and becomes dilated to form a cylindrical receptaculum seminis, which lies obliquely at an angle of about 45° with the longitudinal axis of the worm. The lumen of that part of the vagina which is nearest to the receptaculum is narrower than that of the outer section of the vagina; I have observed cilia lining the vagina at a considerable distance from the external orifice. The *receptaculum seminis* is generally full of sperm. In many cases I have found numerous ova within it. I have not observed autocopulation in this species.

§ *The Uterus and the embedding of Ova in the Parenchyma.*

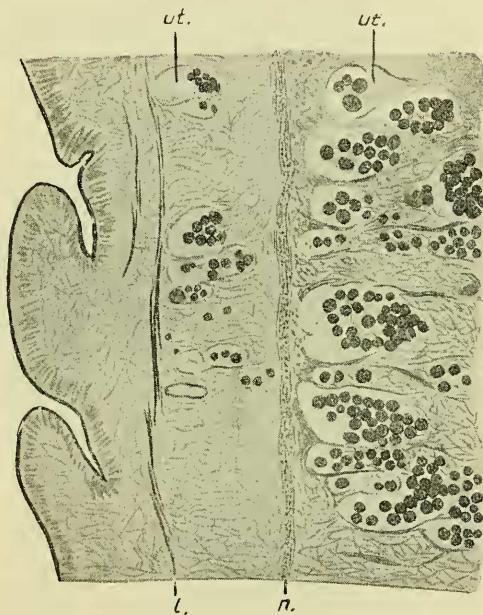
In the genus *Oochoristica* the uterus is not a prominent feature—"Die rasche Entwicklung und der ebenso prompte Zerfall des ursprünglich ventral angelegten Uterus charakterisiert, soweit genauere Untersuchungen ein Urtheil erlauben, das ganze Genus *Oochoristica*," writes Zschokke* in a general survey of the characters of this genus. No precise figures are given as to the duration of the uterus by Zschokke in the species (*O. rostellata*) described in the memoir from which the above quotation has been made. I find myself that, in the species which I describe in the present paper, the uterus is quite obvious in 34 segments, a space of about 10 mm. in length, which is a very appreciable portion of the entire body-length.

The uterus is seen on a general examination to consist of numerous closely adpressed circular to oval chambers, which are more or less filled with eggs. This system of cavities is at first mainly ventral in position. In a series of horizontal sections the ventralmost show only uterine cavities, which extend up to

* Zeitschr. wiss. Zool. lxxxiii. 1905, p. 63.

the anterior, but not up to the posterior, margin of the segment. In fact, they completely underlie the ovary, but not always completely the vitelline gland. In the earliest proglottids which show a uterus, the latter lies only anteriorly and, of course, ventrally. The uterus in the first two or three segments in which it is found consists merely of a transverse tube anteriorly and ventrally, the two ends of which are dilated into two or three more or less oval diverticula, which are thus quite lateral in position. It seems, in fact, to resemble closely the uterus of *Oochoristica rostellata*, as represented in Zschokke's figure*.

Text-figure 5.



Part of a horizontal section through three consecutive segments of *Oochoristica marmosæ*, to show the extension of the uterus laterally.

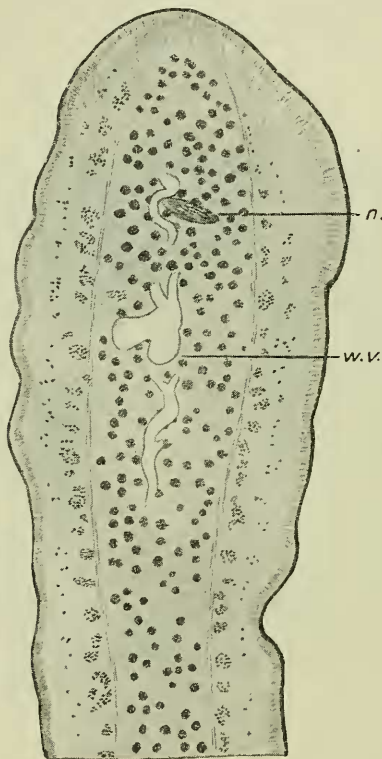
l. Longitudinal muscles. n. Nerve-cord. ut. Uterus.

In later proglottids (text-fig. 5) the uterine cavities range through the medulla much more extensively, and also penetrate into the cortical layer. Finally, the cavities of the uterus are obliterated by growths of the parenchyma, and the individual eggs (or rather embryos) come to lie singly, filling up the entire interior of the proglottid. The development of the uterus, in fact, seems

* Zeitschr. wiss. Zool. Bd. lxxxiii. 1905, Taf. i. fig. 2, v.

to be much as in *O. rostellata*, though Zschokke does not mention the invasion of the cortical layer by uterine spaces. It is to be noted, however, that in my species the extension of the embryos into the cortical layer mainly takes place laterally, and not dorsally or ventrally to any great extent, though here and there I have observed embryos in these regions of the cortical layer.

Text-figure 6.



Half of a transverse section through a nearly completely mature proglottid of *Oochoristica marmosæ*, showing the embryos scattered through the parenchyma.

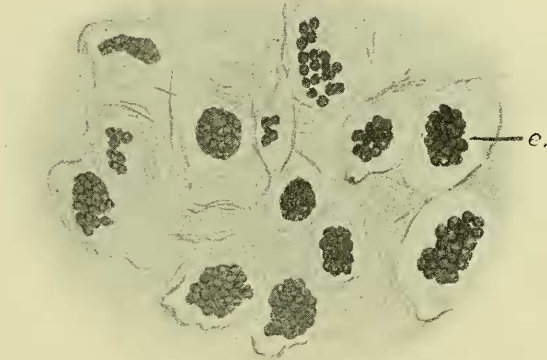
n. Nerve-cord. *w.v.* Water-vascular tubes.

Particularly is the latter the case with the quite mature proglottids, where the embryos are surrounded by their shells.

We may note before proceeding further with the description of the embryos the differences which the uterus shows in the two species dealt with in the present paper. In *Oochoristica marmosæ* the uterus consists of a well-marked posteriorly situated transverse

tube, which gives off oval diverticula laterally. These cavities have well-marked walls, which, however, do not seem to be independent of the surrounding parenchyma; they have no special lining of their own. Later the cavities are multiplied, and the eggs from the very first are confined to these cavities and never lie in the parenchyma between them. The uterus, moreover, exists throughout a good many proglottids. On the other hand, in *Linstowia ameiva* the uterine cavities are less strongly marked off and altogether less definite; they do not form a coherent group and exist for a much shorter period. Moreover, from the very first the ripe ova do not all of them lie within these cavities; they are continually to be found imbedded in the parenchyma between the uterine cavities. The uterus seems to be degenerating in this species as compared with that of *O. marmosa*.

Text-figure 7.



A portion of the same more highly magnified.

The membranes surrounding the embryo (e.) are not yet formed.

The disappearance of the uterus in *Oochoristica marmosa* is followed by a stage (illustrated in text-fig. 6) in which the eggs, which have by this time developed into embryos, are uniformly scattered through the medulla (occasionally invading the cortical layer, as already mentioned) for a considerable number of proglottids, which I am unable to state exactly; the scattered embryos possess no definite shell. They lie (text-fig. 7) in cavities of uniform size separated by meshwork from each other. These cavities resemble in every way the cavities of the parenchyma in various tapeworms, where there is no question of uterine cavities. It must be admitted, however, that such a space as there is round an individual embryo is to be looked

upon as the remains of the uterine cavity. Those who have figured the embryo of *Oochoristica* have, as a rule, not represented this stage, which, however, is not the case with Lühe*, who has represented such embryos in "*Tænia*" *megastoma* Dies.

The first membrane to be formed is a fine one immediately surrounding the embryo. Later on a much thicker and deeply staining outer membrane is formed, which lines the "capsule" of the parenchyma in which the embryo lies. Between these two there is no third membrane. There is thus an important difference between the present species and *Linstowia ameiva* (cf. text-figs. 3, 8), also described in the present communication to the Society. In *Oochoristica marmosa* (text-fig. 8) the eggs

Text-figure 8.



A later stage than that represented in text-fig. 7.

A. Outer membrane. C. Embryo surrounded by thin inner membrane.

have therefore a much clearer appearance, owing to the larger empty space which separates the embryo from the outermost membrane. As to this latter membrane, it is apt to be hexagonal in transverse section, owing to its separation from the embryo and close adherence to the parenchymal walls; and it is not unreasonable to think that it may be a product of the parenchyma rather than of the embryonic cells. This appears to be the opinion of Zschokke† with regard to the uterine ova of *Linstowia semoni*, for he writes: "Die ganze Markscheid ist vollständig angefüllt von derwandigen, rundlichen Bindegewebekapseln, die sich gegenseitig einengen. Jede

* Arch. f. Naturg. 1895, pl. xi, fig. 15.

† "Die Cestoden der Marsupialia, etc.," in Semon's Zool. Forschungsreise, etc., Jan. 1898, p. 368.

Kapsel beherbergt in der Regel ein einziges Ei." The structure figured by Zschokke *, and to which he refers in the above quotation, seems to be of the nature of a membrane and to be therefore quite like the membrane to which I here refer in *Oochoristica marmosæ*. It does not suggest a cellular layer such as I have figured in *Oochoristica* sp. † As to the number of shells, whether thrown off by the embryo or not, which surround the embryo in the genus *Oochoristica*, there appear to be differences among different species. Cohn distinctly represents three shells ‡ in *O. surinamensis*, while Marotel § asserts the presence of only two in the *Oochoristica* of the European Badger, *O. incisa* of Raillet ||.

§ Affinities of the Species.

I have described this species as an *Oochoristica*; into the question of the definition of this genus I propose to enter later. In the meantime, it is necessary to enquire whether—apart altogether from the question of genus—it may not be specifically identical with *Linstowia brasiliensis* ¶ from *Didelphys tristriata*. There is, I think, no possibility of confusing the two species, in spite of many points of general resemblance. In the first place, the simplicity of the water-vascular system of Dr. v. Janicki's species distinguishes it from mine. Furthermore, the fact that in *Linstowia brasiliensis* the ripe eggs of the posterior segments are limited to the lateral areas of the segments militates against the identity of the two species now under consideration. These differences appear to me to be sufficient, without going into a more detailed comparison between *Linstowia brasiliensis* and *Oochoristica marmosæ*. The same remarks apply to *L. iheringi* **.

Oochoristica didelphydis is too small a species (it measures only 15 mm. in length) to be confused with the present one. Furthermore, the scolex was absent, which increases the difficulties of identification. But it agrees with my species in having only two lateral vessels, of which the dorsal has a very fine lumen. On the other hand, the transverse tube is quite simple, which is not the case with that of *O. marmosæ*. The obliquely directed cirrus-sac of *O. didelphydis* contrasts with the perfectly straight one of *O. marmosæ*. The fact that in the former species the vagina opens on to the exterior in front of the cirrus-sac appears to me to be such an important difference, not only from my species, but also from the species of the genus *Oochoristica*, that it leads me to doubt the generic identity of these forms. And I would again point out that while the vagina of *O. marmosæ* is perfectly straight, that of *O. didelphydis* is much coiled. This appears to me to be quite a salient

* Loc. cit. pl. xxiv. fig. 7.

† P. Z. S. 1913. p. 875, text-fig. 149.

‡ Arch. f. Naturg. 1903, p. 65, fig. 9.

§ C. R. Soc. Biol. 1899, p. 21.

¶ Loc. cit. t. cit. p. 23.

|| v. Janicki, Zeitschr. wiss. Zool. lxxxi. p. 507.

** Zschokke, C. Bl. Parasit. xxxvi. 1904, p. 51.

difference, and adds to the possibility of generic difference. Indeed, v. Janicki admits the uncertainty of the inclusion of this species within the genus *Oochoristica*. No information is given of the ripe ova; but a small circular space lying in front of the ovary and marked in his fig. 5 with a "?" is possibly to be regarded as the uterus. In any case, quite apart from the generic identity of "*Oochoristica*" *didelphydis*, there can be no possible comparison between this species and *Oochoristica marmosæ*. The points of difference are too many and too important.

In comparing *Oochoristica marmosæ* with other species of the genus, habitat comes first into consideration and then the systematic position of the host. There are only two species of *Oochoristica* from South American Marsupials known at the present time; and these are *O. bivittata* and *O. didelphydis* recently described by v. Janicki*. *O. bivittata* is a much more slender worm than the one described here by myself; the greatest diameter is only .9 mm. It agrees generally in the unarmed scolex, in the fact that the vagina opens behind the cirrus-sac, and in the imbedding of the ripe eggs singly in the parenchyma, and in smaller details, which are, nevertheless, of systematic importance. There is, in fact, no doubt as to the generic identity of the two worms. The differences, however, are quite of specific value. The complication of the excretory system of *O. marmosæ* contrasts with the simple transverse vessels of *O. bivittata*. It is to be noted, however, that in all three species from *Didelphys* (the genus *Marmosa* but slightly differs from *Didelphys*) there are only two main longitudinal trunks—a point of similarity which is of interest. The generative organs are quite unlike in the two species in a number of features. The position of the gonads contrasts, and the testes are very few in number, in *O. bivittata*. This may, however, be partly due to the maturity of the segments, in one of which they are figured as not exceeding five in number clustered together *behind* the vitelline glands. Finally, the ripe eggs, though scattered singly as in other species of *Oochoristica*, are limited to the sides of the proglottids in *O. bivittata*.

I conclude with a definition of the new species, which is as follows:—

***Oochoristica marmosæ*, sp. n.**

Length at least 54 mm.; diameter 2.8 mm. Scolex unarmed, with suckers directed forwards; genital pores anteriorly situated in proglottid, alternate. Cortex not so wide as medulla. Longitudinal muscles forming a layer of bundles consisting of 15 or more fibres, above which are scattered fibres. Water-vascular system consisting of two longitudinal vessels on each side connected by a rich plexus of rather large branches. Testes very numerous,

* "Studien an Säugethiercestoden," Zeitschr. wiss. Zool. lxxxi. 1906, p. 505; and a preliminary account in Zool. Anz. xxvii. 1904, p. 770.

filling all the available space in the proglottid; cirrus-sac small, opening into a genital cloaca in front of vagina; sperm-duct with a loose coil dividing up into a meshwork of ductules. Ovary anterior in position; vagina with cylindrical receptaculum ovarum. Uterus consists of a posteriorly situated and transverse tube, from which arise numerous diverticula, extending ultimately through most of proglottid; uterus finally disappears, leaving embryos scattered singly throughout parenchyma, extending here and there into cortex. Embryos with two shells.

Hab. American Marsupial, *Marmosa elegans*.

§ *The Genera Oochoristica and Linstowia.*

The fact that *Linstowia* and *Oochoristica* are placed in separate families by systematists at present has tended of itself to exaggerate the differences which exist between these genera. Their real propinquity, however, becomes very apparent when we use the "Key to Genera" devised by Mr. B. H. Ransom*. In this dichotomous table we pursue the two genera side by side until the very last of the characters made use of; they are in this differentiated by the thickness of the cortical layer and the position of the testes in the proglottid. It should be noted that this dichotomous table and the subsequent generic definitions† given by Ransom were published after the information gathered by Zschokke and v. Janicki had been put forward.

When we come to look into the characters of the known species, including those described in the present communication, that have been referred respectively to one or other of the genera *Linstowia* and *Oochoristica*, it does not appear to be at all an easy matter to draw many hard and fast lines of separation. The first-described species of *Linstowia*, not then referred beyond *Tenia* by its original describer‡, has been investigated in further detail by Zschokke§. The salient characters of this worm are the following:—The cortex is thick||; the longitudinal muscle-bundles are in two rows, of which the inner is the thicker, but the bundles have not more than four or five fibres each; the genital cloaca is deep; the cirrus-sac is very large; the vas deferens is coiled and dilates posteriorly, just before it begins to divide, into a kind of vesicula seminalis; the testes extend through the proglottid dorsally; the vitelline gland is quite posterior in position and nothing lies behind it. The excretory tubes lie side by side, and are formed by a transverse vessel in each segment as well as by a network.

Zschokke gives in the same work a fuller account of a second species, viz. *Linstowia semoni*, an example of which serves to fill up certain lacunæ in the generic characters. Of this worm

* Bull. U.S. Nat. Mus. No. 69. 1909, p. 53, &c.

† *Loc. cit.* pp. 65 & 84.

‡ D'Arcy Thompson, Journ. Roy. Micr. Soc. 1903.

§ Zschokke in Semon's Forschungsreise, etc., 1898, pl. xiv, figs. 1 & 2.

|| Thompson, *loc. cit.* pl. v. fig. 8. A transverse section is not figured by Zschokke.

there is no transverse section figured to show the relative thickness of the cortex. The water-vascular system, not figured in *L. echidne*, has as main trunks two tubes on each side, which later lie parallel, and not one above the other, which is the case anteriorly; of these the dorsal tube lies to the outer side of the ventral. There is also a transverse trunk to be seen in each segment. The vagina in this as well as in the last species possesses a dilatation usually termed the receptaculum seminis. The uterus "forms a thin-walled folded tube where the wall is early lost"*, and the eggs come to be imbedded singly in the parenchyma. To these descriptions of the two species it should be added that in both the scolex is unarmed, that the genital pores alternate, and that there is nothing remarkable in the structure of other organs which have not been mentioned.

If we contrast with these species certain forms which have been referred to the genus *Oochoristica* from Edentates rather marked differences at once appear. In such forms as *O. wagneri* and the allied form which I have myself † lately described also from the Lesser Anteater, which may or may not be identical with it, we find the following assemblage of characters. While they agree with the members of the genus *Linstowia*, already referred to, in the unarmed scolex, the alternate generative pores, and the imbedding of the ripe eggs singly in the parenchyma, they differ by the much more complex water-vascular system consisting of six longitudinal tubes; they have also a small cirrus-sac which does not extend far into the body, not reaching much if anything beyond the nerve-cord. If these two groups of species comprised all that were known, the separation of the two genera would be quite easy and obvious. But there are forms which render such a demarcation impossible.

In *O. rostellata* of Zschokke ‡ there are but two water-vascular vessels; though these vessels are superposed instead of lying side by side as in *Linstowia*. On the other hand, in *Linstowia iheringi* and *L. brasiliensis* the cirrus-sac is as small as in *Oochoristica*! While in the species described in the present paper as *Linstowia ameiva*, the cirrus-sac is large (as in the Australian members of the genus *Linstowia*), and the testes are as markedly behind the ovaries as in Janicki's species *Oochoristica bivittata*. As for differences in the relative thickness of the cortex and medulla insisted upon by many, I can see no difference worth mentioning in the figures of *Oochoristica wagneri* and *Linstowia brasiliensis* given by v. Janicki §.

It is thus next to impossible to separate the genera if we accept the present distribution of species among them. Nor is the matter ameliorated if we make the planes of division somewhat different. It had occurred to me to separate off the

* For the species of Australian *Linstowia*, see also Zschokke in Zeitschr. f. wiss. Zool. Bd. lxxv. (1899).

† P. Z. S. 1912, p. 627.

‡ Zeitschr. wiss. Zool. Bd. lxxv.

§ Zeitschr. wiss. Zool. Bd. lxxi, text-fig. 4, p. 534, & pl. xx. fig. 2.

Australian forms limited to that country and to the two groups Marsupials and Monotremes. Here geographical range and the systematic position of the host concur with unusually large cirrus-sac as an anatomical character. But one of the two species, viz. *Linstowia semoni*, has a distinctly larger cirrus-sac than *L. echidnae*; and in my species *L. ameive* the cirrus-sac is not much smaller than that of *L. echidnae*. One structural feature occurs to me as being of possible use in better defining the two genera *Linstowia* and *Oochoristica*. But it is so little known that it cannot be used for the present and may after all turn out to be worthless. This concerns the imbedding of the ova in the parenchyma after the disappearance of the uterus.

I have pointed out*, in describing the ripe eggs of a species of *Oochoristica*, that they are encircled by a cellular layer suggestive of a commencing paruterine organ like that of *Davainea*, etc.

If it be found that this character also signalizes other South American species from Edentates a separation might well be made. Furthermore, it is quite possible that the condition of the uterus may serve as a dividing-line, as it certainly appears to do in the case of two other mutually related genera, viz. *Inermicapsifer* and *Zschokkeella*†. The kind of difference that is meant by this suggestion is that shown by the two species described in the present paper, and has been put forward in detail above, accompanied by illustrations (text-figs. 2 & 5). In the meantime, it does not seem possible to form a reasonable definition of the two genera, and I am strongly of opinion that there are no grounds at all for placing *Oochoristica* and *Linstowia* in separate families.

* In a paper upon a new genus *Eugonodæum* in P. Z. S. 1913, p. 875, text-fig. 149.

† See P. Z. S. 1912, p. 607.